California Energy Commission
Public Interest Energy Research (PIER) Program
ENVIRONMENTAL AREA RESEARCH

Air Quality and Emissions Impacts of Heat Island Mitigation Strategies

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Fact Sheet

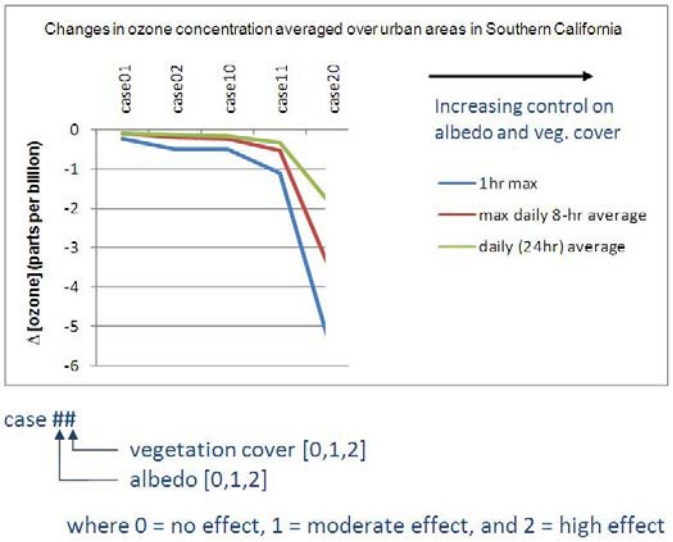
The Issue

As pavements and buildings replace vegetation and natural surfaces, more heat is absorbed, increasing the temperature of the ground surface and the ambient air. This situation creates areas called urban heat islands. Urban heat islands can be 2 – 10 degrees Fahrenheit hotter than the surrounding countryside on summer days.

Changing the urban landscape by using less heat-absorbing materials and by increasing vegetation is called heat island mitigation, which can lower urban temperatures. Having lower ambient summertime temperatures reduces electricity demand for air conditioning, which lowers air pollution levels by generating fewer emissions from electricity production.

These benefits, however, are difficult to measure and, to date, have not been used in California as an emissions reduction strategy in the air quality planning process. If a model were available to accurately predict the decrease in temperature, electricity use, emissions, and ozone formation, then the electricity reductions and air quality improvements could be quantitatively documented.

Quantifying emissions equivalents in a more accurate and detailed manner is important if heat island control strategies are to be viewed as "quantifiable" and "enforceable," which the



Changes in ozone concentration averaged over urban areas in Southern California using simulated urban heat island mitigation for August 5, 1997. As air temperature decreases, ozone concentration decreases as well.
Source: Haider Taha, Altostratus, Inc., California Energy Commission Contract #500-08-007

U.S. Environmental Protection Agency requires to adopt a new strategy and to provide credits and incentives for its implementation.

Currently, no method exists for assessing emissions equivalents for heat island mitigation strategies that is quantifiable and enforceable for use in state implementation plans, or for comparison with other emissions reduction strategies. If found to be cost effective, heat island mitigation could be used as a strategy for reducing peak electricity demand as well as for meeting federal and state ozone air-quality standards.

Benefits of distributed generation solar systems include reducing energy consumption and reducing reliance on the electrical grid. However, how large-scale solar systems in the urban area may impact the heat island effect is unknown. This study will also develop an initial scoping of targeted design considerations, implementation plans, and an initial evaluation of solar energy systems' potential air quality benefits and impacts.

Project Description

This project will model and analyze the air quality and electricity impacts of potential urban heat island mitigation across different summer conditions to try to better predict the overall benefits and impacts of these strategies. These simulation results will then be used for a detailed analysis of the conversion of simulated ozone changes into emissions equivalents.

The project's goals are to:

- Develop better quantification of methods used to reduce the heat island effect.
- Develop a method for assessing ozone reductions and emissions equivalents for heat island mitigation strategies. This assessment method must be considered quantifiable and enforceable for use in state implementation plans for air quality improvement.
- Analyze the potential effects of large-scale urban solar systems on urban heat islands.

PIER Program Objectives and Anticipated Benefits for California

Reducing the heat island effect will reduce outside air temperatures and the associated demand for cooling of buildings. Heat island mitigation can lower urban temperatures, resulting in lower electricity demand and reduced associated air pollution and economic costs. This outcome translates into lower electricity bills for California residents, improved air quality, and reduced adverse health impacts associated with air pollution, including reduced health care costs.

This project helps achieve California's goal to support the most cost-effective and environmentally sound strategies while accounting for the environmental impacts associated with energy production, planning, and procurement.

Project Specifics

Contract Number: 500-08-007
Contractor: Altostratus, Inc.
City/County: Martinez, Contra Costa County
Application: Statewide
Amount: $200,000
Term: April 2009 to December 2011

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